EARTH'S ATMOSPHERE

Name _____ Lab No. _____

Date _____ Class _____

Earth is surrounded by a life-giving gaseous envelope called the **atmosphere** . This blanket of air is an important part of our planet. It provides the air that we need to breathe ; it also protects us from the sun's dangerous radiation. The energy exchanges that continuosly occur within the atmosphere produce the effects we call weather.

In this lab investigation, you will study the layers of the atmosphere, and the changes in temperature, density, pressure, and composition that occur within these layers.

References : _____

Material : colored pencils

Procedure :

1. The atmosphere is commonly divided into four layers on the basis of *temperasture changes*.. These four layers are the : troposphere , stratosphere , mesosphere , and thermosphere. Complete **Diagram 1** on page 2 by following the steps below.

   (1) Label **troposphere , stratosphere , mesosphere,** and **thermosphere**

   (2) Use colored pencils to shade each layer a different color.

   (3) Label the boundaries (interfaces) : **tropopause , stratopause ,** and **mesopause.**

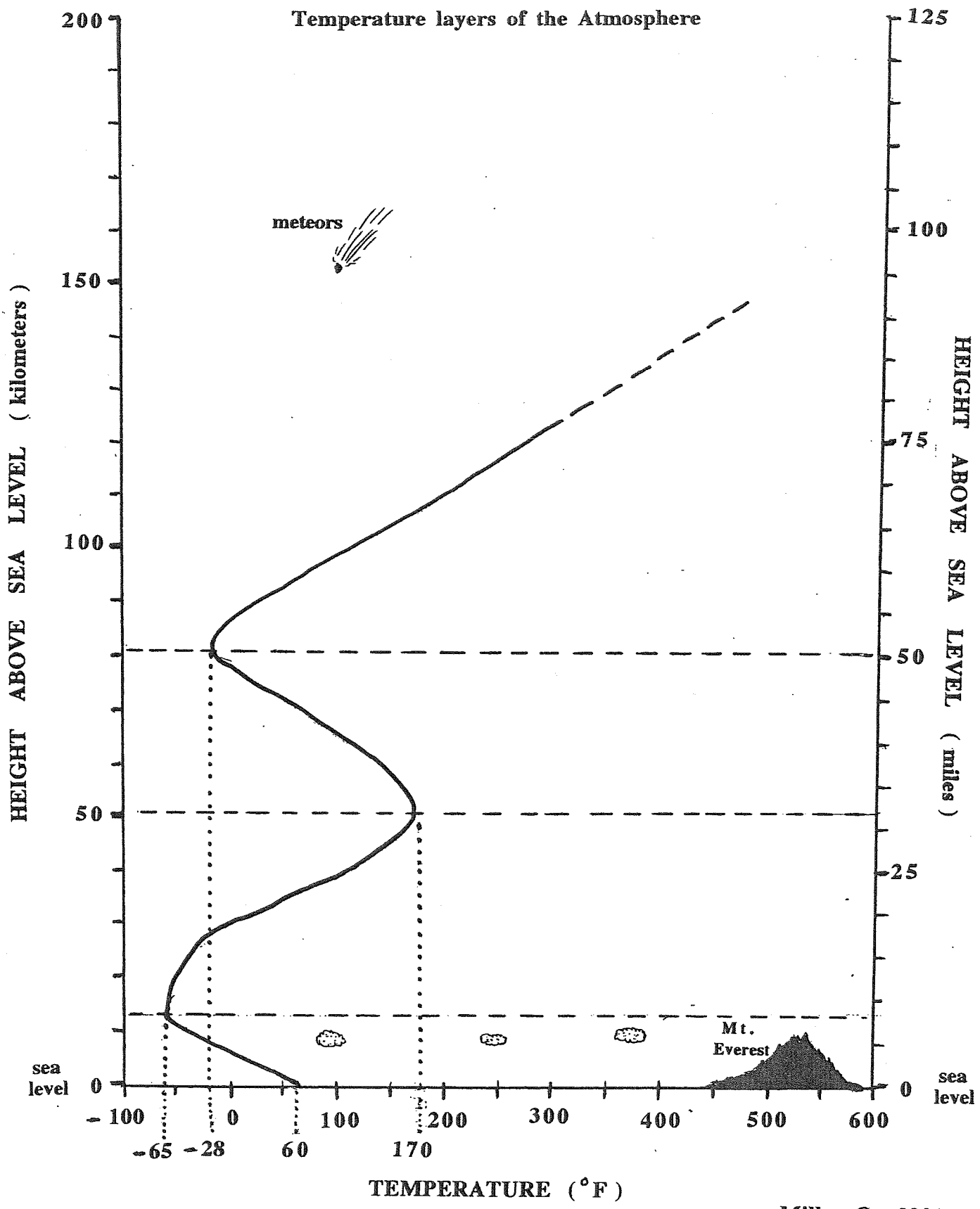
2. Use Diagram 1 to determine the altitude of each of the boundaries .

   (1) **Tropopause :** _____ **kilometers** = _____ **miles**

   (2) **Stratopause :** _____ **kilometers** = _____ **miles**

   (3) **Mesopause :** _____ **kilometers** = _____ **miles**

DIAGRAM 1



3. Use Diagram 1 to complete the following statements by writing : increases , decreases , or remains the same.

(1) As altitude in the troposphere increaes , the temperature _____.

(2) As altitude in the stratosphere increases, the temperature _____.

(3) As altitude in the mesosphere increases, the temperature _____.

(4) As altitude in the thermosphere increases, the temperature _____.

4. According to Diagram 1 , what is the temperature at :

(1) sea level _____ (3) the stratopause _____

(2) the tropopause _____ (4) the mesopause _____

REFER TO DIAGRAM 2 ON PAGE 4 FOR QUESTIONS 5 THROUGH 8

5. Complete the following statement to express the relationship between altitude and the density of the atmosphere.

As altitude increases , the density of the atmosphere _____.

6. By referring to Diagram 2, determine the approximate density (in grams per cubic meter) of air at :
As an example , sea level has been completed.

(1) sea level : $10^3 - 10^4$ = 1000 - 10,000 g/m^3.

(2) the tropopause : _____ = _____ g/m^3

(3) the stratopause : _____ = _____ g/m^3

(4) the mesopause : _____ = _____ g/m^3

7. Complete the following statement to express the relationship between altitude and atmospheric preesure.

As altitude increases , atmospheric pressure _____.

8. By referring to Diagram 2 , determine the approximate atmospheric pressure , in atmospheres, at :
As an example , sea level has been completed. Also note : an atmosphere is a unit of air pressure ; 1 atmosphere equals average air pressure at sea level under normal conditions ; 1 atmosphere equals 14.7 pounds per square inch or 29.92 inches of mercury .

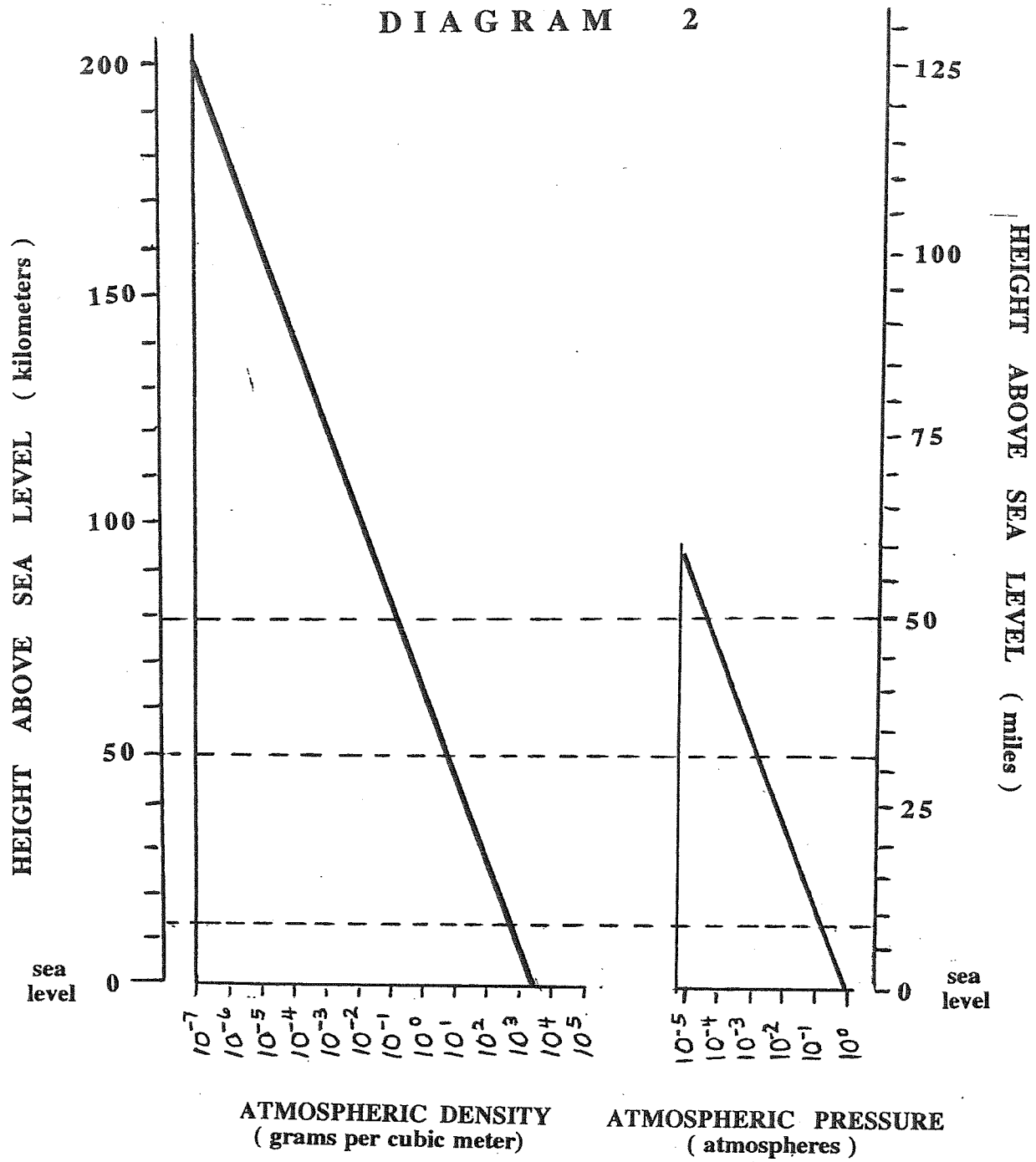
(1) sea level : 10^0 = 1 **atmospheres**

(2) the tropopause : _____ = _____ **atmospheres**

(3) the stratopause : _____ = _____ **atmospheres**

(4) the mesopause : _____ = _____ **atmospheres**

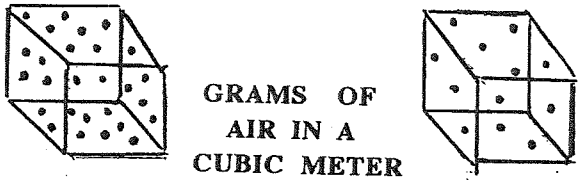
DIAGRAM 2



Reference : Powers of 10	
10^{3}	= 1000
10^{2}	= 100
10^{1}	= 10
10^{0}	= 1
10^{-1}	= .1
10^{-2}	= .01
10^{-3}	= .001

Reference : Density

$$\text{DENSITY} = \frac{\text{MASS}}{\text{VOLUME}}$$



GRAMS OF AIR IN A CUBIC METER

MORE DENSE

LESS DENSE

9. The atmosphere can also be divided into two layers , or "spheres", on the basis of *composition* .These layers are called the homosphere and the heterosphere. The **homosphere** is a mixture of gases which include : 78 % nitrogen , 21 % oxygen , and 1 % of other gases such as carbon dioxide, argon, and hydrogen. The homosphere extends from Earth's surface to an altitude of 120 kilometers / 75 miles. Above this altitude is the heterosphere. In **Diagram 3** below, complete the following steps :

(1) Draw a line to separate the homosphere from the heterosphere.

(2) Label the homosphere and heterosphere on the right-hand side of the diagram. Use brackets or double arrrows as illustrared :

} homosphere OR ↑ heterosphere ↓

(3) Lightly shade the homosphere with a colored pencil.

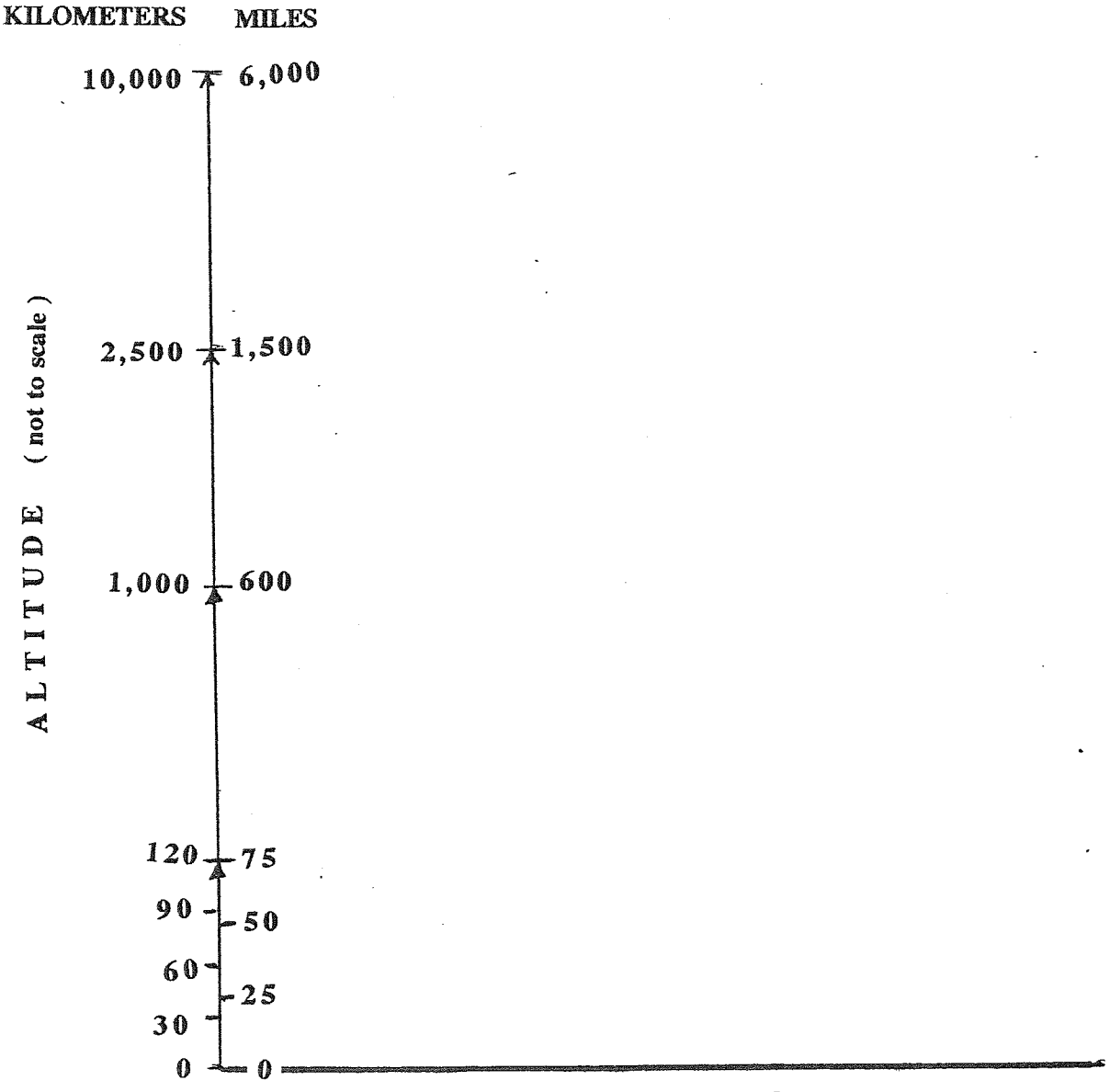


DIAGRAM 3

Composition Layers of the Atmosphere

10. The **heterosphere** consists of three separate single-gas layers.
(a) the oxygen layer between the altitudes of 120 kilometers and 1,000 kilometers
(b) the helium layer between the altitudes of 1,000 kilometers and 2,500 kilometers
(c) the hydrogen layer between the altitudes of 2,500 kilometers and 10,000 kilometers.
In **Diagram 3**, complete the following steps :

(1) Draw lines to separate he threeparts of the heterosphere.

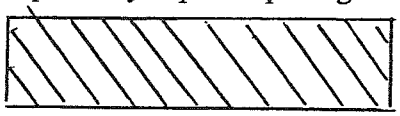
(2) Within each region of the atmosphere, label these layers : **oxygen , helium ,** and **hydrogen.**

(3) Using a different colored pencil, lightly shade each region.

11. Within the homosphere is the **ozone layer**. The ozone layer is between the altitudes of 15 and 40 kilometers. The ozone layer is a region of the atmosphere where there is a concentration of ozone molecules ; ozone molecules consist of three oxygen atoms, and not two oxygen atoms like regular oxygen molecules : O_3 = ozone ; O_2 = oxygen. The ozone layer filters-out and absorbs much of the dangerous ultra violet radiation coming from the sun ; this warms the air of the stratosphere. By absorbing / filtering-out dangerous ultra violet radiation, the ozone layer protects life on Earth.

In **Diagram 3,** complete the following steps :

(1) Show the ozone region within the homosphere by super-imposing this symbol :



(2) Label this region **OZONE.**

12. Within the oxygen layer of the heterosphere is the **ionosphere**. The ionosphere is between the altitudes of 80 and 400 kilometers. Within this region of the atmosphere, dangerous gamma rays , X-rays and ultra violet rays from the sun are absorbed / filtered out ; this process warms the thermosphere. Like the ozone layer, the iono - sphere protects life on Earth from dangerous solar radiation. Solar radiation bombards atoms of oxygen (and some nitrogen) knocking out electrons to form positively charged ions of oxygen (and some nitrogen). These free ions and free electrons form the ionosphere.

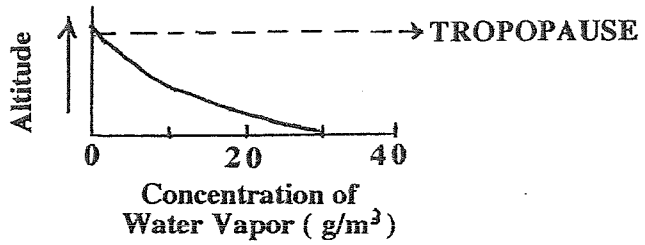
The ionosphere plays an important role in long distance radio communication. Radio waves of certain wavelengths (frequencies) are reflected by the ionosphere. This makes it possible to send radio waves long distances around the curved surface of Earth. Otherwise, these radio waves would travel in a straight line and go out into space.

In **Diagram 3**, complete the following steps :

(1) Show the ionosphere within the oxygen layer of the heterosphere by super-imposing this symbol :

(2) Label this region **IONOSPHERE.**

13. The graph below shows the relationship between altitude and the amount of water vapor in the atmosphere.



(1) Based on this graph, almost all water vapor in the atmosphere is found in the

_____ layer.

(2) Within this layer, as the altitude increases, the amount of water vapor

_____.

14. Determine the rate of temperature decrease in the troposphere as altitude increases.

(1) STEP 1 : Determine the thickness of the troposphere, from Earth's surface to the tropopause.

_____ **miles**

(2) STEP 2 : Determine the temperature change the occurs from Earth's surface to the tropopause.

Temperature at Earth's surface _____ °F ; temperature at the tropopause _____ °F

a total temperature change of _____ °F

(3) STEP 3 : Determine the rate of temperature change by using the following equation :

$$\text{RATE} = \frac{\text{change in temperature}}{\text{distance}}$$

The rate of temperature change (decrease) in the troposphere as the altitude increases is

_____ **° F / mile .**

15. Answer the following questions :

(1) What is the beneficial role of the ozone layer ? _____

_____

_____

(2) What happens to most meteors that enter Earth's atmosphere ? _____

_____

_____

(3) What is the beneficial role of the ionosphere ? _____

_____

_____

(4) What causes the atmosphere to become warmer in both the stratosphere and the thermosphere ?

_____

_____

_____